

General

Title

Overuse of imaging: percentage of children, ages 4 through 17 years old, for whom imaging of the head (CT or MRI) is obtained for the evaluation of primary headache without indications for neuroimaging, including neurologic deficit lasting longer than 60 minutes, signs and symptoms of increased intracranial pressure, or lumbar puncture.

Source(s)

Quality Measurement, Evaluation, Testing, Review and Implementation Consortium (Q-METRIC). Basic measure information: overuse of imaging for the evaluation of children with primary headache. Ann Arbor (MI): Quality Measurement, Evaluation, Testing, Review, and Implementation Consortium (Q-METRIC); 2016 Jan. 67 p.

Measure Domain

Primary Measure Domain

Clinical Quality Measures: Process

Secondary Measure Domain

Does not apply to this measure

Brief Abstract

Description

This measure is used to assess the percentage of children, ages 4 through 17 years old, for whom imaging of the head (computed tomography [CT] or magnetic resonance imaging [MRI]) is obtained for the evaluation of primary headache without indications for neuroimaging, including neurologic deficit lasting longer than 60 minutes, signs and symptoms of increased intracranial pressure, or lumbar puncture.

Primary headache must be diagnosed on the day of or 30 days prior to imaging. A lower percentage indicates better performance, as reflected by avoiding imaging when it is not indicated.

Rationale

Headaches are divided into two main classifications: primary headaches, such as migraine or tension headaches, and secondary headaches, which represent headaches attributed to a separate condition, such as infection, trauma, tumors, or vascular problems (International Headache Society [IHS], 2014). Headaches are common in the pediatric population (Lateef et al., "Headache in national sample," 2009). Children with headaches are frequently evaluated in emergency departments (EDs) and primary care settings (DeVries et al., 2013; National Hospital Ambulatory Medical Care Survey, 2011). Although most headaches are not symptomatic of underlying disease, the differential diagnosis list for headache is long, with over 300 different types and causes (Evans, 1996).

Computed tomography (CT) and magnetic resonance (MR) of the brain are radiologic modalities used to create images of internal structures in a slice-by-slice manner. CT uses X-ray radiation (hereafter simply called radiation), and MR uses magnetic fields and radio waves. Rationales for obtaining neuroimaging to characterize headache include evaluation for suspected secondary causes such as arteriovenous malformation or tumor, patient and parental anxiety about the potential for underlying vascular problems or tumor related to severe and/or recurrent head pain, and legal concerns for a missed diagnosis on the part of health care providers.

Neuroimaging is increasingly used to evaluate pediatric patients who experience headache (Broder, Fordham, & Warshauer, 2007; Graf et al., 2008; Larson et al., 2011). The yield of neuroimaging in the evaluation of patients with primary headache and a normal neurologic examination is quite low (Hayes et al., 2012; Chu & Shinnar, 1992; Evans, 1996; Gandhi et al., 2015; Lateef et al., "Headache in young," 2009; Lateef et al., 2012) and exposes children to unnecessary risks. To decrease unnecessary neuroimaging, evidence-based practice guidelines have been developed. These guidelines advise against neuroimaging for headaches unless specific clinical criteria are met (Hayes et al., 2012). For children with neurologic deficits lasting longer than 60 minutes or with signs and symptoms of increased intracranial pressure, neuroimaging is indicated.

This measure is focused on the overuse of CT and MRI for the evaluation of children with headache, a problem that has gained national attention in recent years (Loder et al., 2013). Overuse has been defined as any patient who undergoes a procedure or test for an inappropriate indication (Lawson et al., 2012). Imaging overuse subjects children to a number of risks (Malviya et al., 2000; Mathews et al., 2013; Pearce et al., 2012; Wachtel, Dexter, & Dow, 2009). Children who are exposed to radiation as a result of CT scans in early life are at greater risk for developing leukemia, primary brain tumors, and other malignancies later in life (Mathews et al., 2013; Pearce et al., 2012). Children who require sedation or anesthesia for longer CT imaging sequences and almost universally for MRI studies are also at risk for complications. These complications include compromised airway, hypoxia leading to central nervous system injury, and death. Additionally, CT and MRI overuse creates cost burdens for the patient, as well as for payers.

Evidence for Rationale

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Quality Measurement, Evaluation, Testing, Review and Implementation Consortium (Q-METRIC). Basic measure information: overuse of imaging for the evaluation of children with primary headache. Ann Arbor (MI): Quality Measurement, Evaluation, Testing, Review, and Implementation Consortium (Q-METRIC); 2016 Jan. 67 p.

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Primary Health Components

Primary headache; computed tomography (CT); magnetic resonance imaging (MRI); overuse; children

Denominator Description

The denominator is the number of children, ages 4 through 17 years old, for whom imaging of the head (computed tomography [CT] or magnetic resonance imaging [MRI]) is obtained for the evaluation of primary headache. See the related "Denominator Inclusions/Exclusions" field.

Numerator Description

The numerator is the number of children, ages 4 through 17 years old, for whom imaging of the head (computed tomography [CT] or magnetic resonance imaging [MRI]) is obtained for the evaluation of primary headache without indications for neuroimaging. See the related "Numerator Inclusions/Exclusions" field.

Evidence Supporting the Measure

Type of Evidence Supporting the Criterion of Quality for the Measure

A clinical practice guideline or other peer-reviewed synthesis of the clinical research evidence

A formal consensus procedure, involving experts in relevant clinical, methodological, public health and organizational sciences

A systematic review of the clinical research literature (e.g., Cochrane Review)

One or more research studies published in a National Library of Medicine (NLM) indexed, peer-reviewed journal

Additional Information Supporting Need for the Measure

Primary Headache Prevalence and Incidence

Headaches are common in the pediatric population (Lateef et al., "Headache in a national," 2009). Children with headaches are frequently evaluated in emergency departments (EDs) and primary care settings (DeVries et al., 2013; National Hospital Ambulatory Medical Care Survey, 2011). Headaches occur more often as children grow older (Hayes et al., 2012). At age 7 years, prevalence ranges from 37% to 51%. By age 15 years, 57% to 82% of children have experienced a headache. And among 16-year-olds, 93% or more have reported experiencing a severe headache (Hayes et al., 2012). Before puberty, boys are more likely than girls to experience headache. The situation is reversed after puberty, when headaches are more commonly reported in girls (Hayes et al., 2012).

Primary Headache Pathology and Severity

The precise pathophysiology of primary headaches is still not fully understood, but research suggests that complex interactions between the neural and vascular systems are involved (Edvinsson, 2001). The manifestation and perception of headache is unique and specific to the child who experiences it. Correspondingly, the management approach for children with primary headaches often focuses on reassurance and education by the clinician who evaluates the child (Brna & Dooley, 2006; Raieli et al., 2010).

Burdens of Overuse of Imaging for Primary Headache: Radiation, Sedation/Anesthesia, and Intravenous Contrast Risks; Cost

The literature offers many examples of the potential risks associated with imaging. Chief among these are risks related to radiation (Mathews et al., 2013; Pearce et al., 2012), sedation and/or anesthesia (Malviya et al., 2000; Wachtel, Dexter, & Dow, 2009), and intravenous contrast media (Zo'o et al., 2011). Cost is also an issue (Callaghan et al., 2014).

Radiation-Related Burden and Risk. Radiation exposure associated with computed tomography (CT)-imaging introduces the possibility of chronic health risks related to malignancies sustained from radiation effects (Berrington de González et al., 2009; Mathews et al., 2013; Pearce et al., 2012). Children have developing cellular structures and tissues that are significantly more radiosensitive than those of adults; children, therefore, will be at substantially elevated risk for malignancy following radiation exposure from CT imaging (Hayes et al., 2012). Radiosensitive organs—including the brain, bone marrow, lens of the eye, and thyroid gland—can be exposed to radiation during CT of the head (Papadakis et al., 2011). In children younger than 5 years of age, about 20% of the active bone marrow is in the cranium, compared with 8% in adults (Cristy, 1981).

To conduct imaging studies with radiation dosing that is appropriate for children, many facilities follow policies and protocols using the concept of ALARA—as low as reasonably achievable. ALARA principles deem any additional radiation beyond the minimum needed for interpretable images both detrimental and non-efficacious (American College of Radiation [ACR], 2009). Professional practice and patient advocacy groups including the ACR, the American Academy of Neurology (AAN), and the American Academy of Pediatrics (AAP) have developed and promoted ALARA protocols and policies; these guidelines support the use of CT imaging only when clinically indicated in children, decreasing the risk of harm from radiation.

Sedation- and Anesthesia-Related Burden and Risk. Use of sedation may be necessary to avoid motion artifacts, which invariably occur if the child moves during the image acquisition, thus interfering with image quality. Motion artifacts sometimes undermine imaging quality to the point of rendering images unreadable. In the case of CT imaging, this may result in additional radiation exposure to obtain images sufficient for interpretation.

Although the sedation used for pediatric imaging has been identified as low risk, it does have potential attendant complications (Cravero et al., 2006; Malviya et al., 2000). Levels of sedation are on a continuum from minimal anxiolysis (administration of an anxiety reduction agent) to deep sedation, in which the patient can be roused only via vigorous stimuli (Arthurs & Sury, 2013). Compared with minimal sedation, moderate and deep sedation carry a greater risk of airway compromise, hypoxia resulting in central nervous system injury, and death (Cravero et al., 2006).

In certain instances, sedation may not be sufficient, and anesthesia will be required to complete imaging. Anesthesia includes administration of medication that results in some degree of respiratory suppression and potential for cardiac depression; the patient cannot be roused by external stimuli or commands (Arthurs & Sury, 2013). Administration of anesthesia raises risks related to the process of intubation for respiratory support. These risks include dental trauma; airway edema (swelling of the windpipe); vocal cord spasm or injury; regurgitation of stomach contents with subsequent aspiration (inhalation) pneumonia; injury to arteries, veins, or nerves; alterations in blood pressure; and/or irregular heart rhythms (Society for Pediatric Anesthesia, 2014). The most severe, though rare, risks include brain damage and death (Society for Pediatric Anesthesia, 2014).

Intravenous Contrast-Related Burden and Risk. During the course of CT and magnetic resonance imaging

(MRI) studies, intravenous (IV) contrast media may be used to enhance visualization of vascular structures and provide important information about neurologic anatomy. It is possible a child may experience an allergic reaction to IV contrast or subcutaneous fluid leakage (extravasation) during administration of IV contrast. IV contrast administration also includes the risk of contrast-induced nephrotoxicity (CIN) (Bansal et al., 2014; Zo'o et al., 2011). Children with poor kidney function are at greater risk for developing CIN and, in rare cases, will develop renal failure requiring dialysis.

Cost-Related Burden. Overuse of imaging is costly and places additional strain on an already heavily burdened health care system (Callaghan et al., 2014). As an example, charges for a CT of the brain can be as much as \$2,000 and can vary substantially by region of the country. In addition, the likelihood that neuroimaging will result in the identification of clinically important structural abnormalities in this patient population is low. Incidental findings, however, may require follow-up testing with associated charges and potential complications (Lumbreras, Donat, & Hernández-Aguado, 2010; Rogers et al., 2013).

Performance Gap

The yield of neuroimaging in the evaluation of patients with primary headache and a normal neurologic examination is quite low (Hayes et al., 2012; Chu & Shinnar, 1992; Evans, 1996; Gandhi et al., 2015; Lateef et al., "Headache in young," 2009; Lateef et al., 2012) and exposes children to unnecessary risks. Currently, professional guidelines do not support neuroimaging for primary headache in the absence of persistent neurologic deficits or documented neurologic signs or symptoms that suggest increased intracranial pressure (Hayes et al., 2012; Alexiou & Argyropoulou, 2013; Lewis et al., 2002). While many children with headaches will not benefit from neuroimaging, children experiencing headaches associated with new neurologic deficits or signs and symptoms of increased intracranial pressure may have underlying pathology that can be identified through imaging.

Drivers of Overuse

Primary headache experienced by a child, especially when recurrent, can be a stressful event that may prompt a parent to seek the assistance of a health care provider, at times emergently. Some providers may feel pressured by the parent to order imaging despite a lack of benefit (Daymont et al., 2014; Raieli et al., 2010). This circumstance has a close parallel with parents who seek antibiotics for a child who has viral respiratory symptoms. In these circumstances, the provider may deviate from established practice guidelines to placate the parent. In recent decades, this phenomenon has reached such wide-spread prominence as to prompt multidisciplinary initiatives targeted at fostering discussion and identifying common practices that should be questioned by parents and providers (AAP, 2013). An ongoing dialogue between parents and providers continues to be a key feature of optimal outcomes in the setting of primary headache.

The practice of defensive medicine is another reason an imaging study may be ordered. Physicians may be uncomfortable facing uncertainty about missing intracranial pathology in children they are evaluating and treating for headache. Assurance behaviors (e.g., ordering of additional tests) are expected when a malpractice-sensitive physician is faced with a potentially worrisome condition (e.g., intracranial hemorrhage) that can cause the symptom in question (e.g., a headache) (Carrier et al., 2013). In a survey of physicians from six specialties at high risk of liability, emergency physicians ordered more unnecessary diagnostic tests than clinicians from any other specialty (Studdert et al., 2005). Physicians practicing in the ED have the added challenge of limited access to detailed medical records, which increases uncertainty about prior evaluation of patients who are referred from an out-of-network provider or hospital. Unnecessary ordering of neuroimaging is a potential result.

See the original measure documentation for additional evidence supporting the measure.

Evidence for Additional Information Supporting Need for the Measure

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Extent of Measure Testing

Reliability

This measure was tested using inter-rater reliability (IRR) of medical record data, as described below.

Abstracted Medical Record Data. Medical record data were obtained through HealthCore, Inc., an independent subsidiary of Anthem, Inc., the largest health benefits company/insurer in the United States. HealthCore owns and operates the HealthCore Integrated Research Database (HIRD), a longitudinal database of medical and pharmacy claims and enrollment information for members from 14 geographically diverse Blue Cross and/or Blue Shield (BCBS) health plans in the Northeast, South, West, and Central regions of the United States, with members living in all 50 states. The HIRD includes automated computerized claims data and enrollment information for approximately 60 million lives with medical enrollment, over 37 million lives with combined medical and pharmacy enrollment information, and 16 million lives with outpatient laboratory data from the BCBS licensed plans.

This measure belongs to the Quality Measurement, Evaluation, Testing, Review, and Implementation Consortium (Q-METRIC) Overuse of Imaging for the Evaluation of Children with Headache or Seizures measures collection. As part of the initial sampling strategy for testing multiple measures in this collection, approximately 2.1 million children, ages 6 months through 17 years old, were identified in the HIRD for the study's 2012 measurement year. Of these, a cohort of children with diagnosis codes for headaches and seizures were identified (57,748). Members who did not have continuous eligibility during the 2011 and 2012 calendar years were excluded, narrowing the group to 36,985. Specifically for this measure, administrative claims were used to determine the number of children 4 through 17 years of age who had a primary headache (26,991, 73.0%). From this group, 4,390 children (16.3%) were identified as having either computed tomography (CT) or magnetic resonance imaging (MRI). After applying claims denominator exclusions, 2,674 children (60.9%) remained eligible for the denominator. Among those children, a total of 478 children (17.9%) were excluded from the numerator based on information available from claims data for either receipt of lumbar puncture (n=35) or indicators of increased intracranial pressure (n=443), resulting in a rate of overuse of imaging for primary headache of $2196/2674 = 82.1\%$.

Among the children eligible for the denominator based on claims, providers associated with the eligible children's visits were identified; the final sampling population consisted of 2,007 children (75.1%) who were linked to a provider with available contact information. Once subjects were identified, patient medical records were requested from provider offices and health care facilities; records were sent to a centralized location for data abstraction. To ensure an adequate number of cases to test the feasibility of

this measure, a target sample of 200 abstracted charts was set.

Trained medical record abstractors collected and entered information from paper copies of the medical records into a password-protected database. To help ensure consistency of data collection, the medical record abstractors were trained on the study's design and presented with a standardized data collection form designed to minimize the need to make subjective judgments during the abstraction process. In addition, data were entered onto forms, which were subsequently scanned and reviewed through a series of quality checks.

In total, 191 charts were reviewed for the presence of denominator exclusions that were not present in claims. There were 36 children (18.8%) with documentation of a condition that met denominator exclusion within the chart, resulting in a total of 155 (81.2%) children who met denominator criteria for this measure. Among patients eligible for the denominator, imaging was obtained without a documented indication for 132 children ($132/155=85.2\%$).

Inter-Rater Reliability (IRR). Reliability of medical record data was determined through re-abstraction of patient record data to calculate the IRR between abstractors. Broadly, IRR is the extent to which the abstracted information is collected in a consistent manner. Low IRR may be a sign of poorly executed abstraction procedures, such as ambiguous wording in the data collection tool, inadequate abstractor training, or abstractor fatigue. For this measure, the medical record data collected by three abstractors was individually compared with the data obtained by a senior abstractor. Any differences were remedied by review of the chart. IRR was determined by calculating both percent agreement and Cohen's kappa statistic.

Of the 191 medical records received for chart review, 30 records (15.7%) were reviewed for IRR. IRR was assessed by comparing abstractor agreement with a senior abstractor on 11 data elements included in the chart abstraction form for this measure. Overall, abstractor agreement was 100%; the kappa statistic was 1.0, indicating that a perfect level of IRR was achieved. Given this evidence, the data elements needed for calculation of the measure can be abstracted from medical records with a high degree of accuracy.

Validity

Face Validity. The face validity of this measure concept was established by a national panel of experts and parent representatives for families of children with headaches and seizures convened by Q-METRIC. The Q-METRIC panel included nationally recognized experts in the area of imaging children, representing general pediatrics, pediatric radiology, pediatric neurology, pediatric neurosurgery, pediatric emergency medicine, general emergency medicine, and family medicine. In addition, face validity of this measure was considered by experts in state Medicaid program operations, health plan quality measurement, health informatics, and health care quality measurement. In total, the Q-METRIC imaging panel included 15 experts, providing a comprehensive perspective on imaging children and the measurement of quality metrics for states and health plans.

The Q-METRIC expert panel concluded that this measure has a high degree of face validity through a detailed review of concepts and metrics considered to be essential to appropriately imaging children. Concepts and draft measures were rated by this group for their relative importance. This measure received an average score of 5.6 (with 9 as the highest possible score).

Refer to the original measure documentation for additional information.

Evidence for Extent of Measure Testing

Quality Measurement, Evaluation, Testing, Review and Implementation Consortium (Q-METRIC). Basic measure information: overuse of imaging for the evaluation of children with primary headache. Ann Arbor (MI): Quality Measurement, Evaluation, Testing, Review, and Implementation Consortium (Q-METRIC); 2016 Jan. 67 p.

State of Use of the Measure

State of Use

Current routine use

Current Use

not defined yet

Application of the Measure in its Current Use

Measurement Setting

Ambulatory/Office-based Care

Ambulatory Procedure/Imaging Center

Emergency Department

Hospital Inpatient

Hospital Outpatient

Managed Care Plans

Professionals Involved in Delivery of Health Services

not defined yet

Least Aggregated Level of Services Delivery Addressed

Single Health Care Delivery or Public Health Organizations

Statement of Acceptable Minimum Sample Size

Specified

Target Population Age

Ages 4 to 17 years

Target Population Gender

Either male or female

National Strategy for Quality Improvement in Health Care

National Quality Strategy Aim

Better Care

National Quality Strategy Priority

Making Care Safer

Prevention and Treatment of Leading Causes of Mortality

Institute of Medicine (IOM) National Health Care Quality Report Categories

IOM Care Need

Getting Better

IOM Domain

Effectiveness

Safety

Data Collection for the Measure

Case Finding Period

The measurement year

Denominator Sampling Frame

Enrollees or beneficiaries

Denominator (Index) Event or Characteristic

Clinical Condition

Diagnostic Evaluation

Patient/Individual (Consumer) Characteristic

Denominator Time Window

not defined yet

Denominator Inclusions/Exclusions

Inclusions

The denominator is the number of children, ages 4 through 17 years old, for whom imaging of the head

(computed tomography [CT] or magnetic resonance imaging [MRI]) is obtained for the evaluation of primary headache.

Note:

Eligible children are 4 through 17 years old during the measurement year for which imaging of the head is obtained and must be continuously enrolled in their insurance plan during both the measurement year and the year prior. Primary headache must be diagnosed on the day of or 30 days prior to imaging. Table 1 (refer to the original measure documentation) lists Current Procedural Technology (CPT) codes associated with brain imaging. Table 2 (refer to the original measure documentation) lists International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes for types of primary headaches: migraines, tension headaches, and cluster headaches. Children with secondary headaches, attributable to a separate condition such as infection, trauma, tumors, or blood vessel problems, are not eligible for inclusion in this measure.

Exclusions

Exclusions based on ICD-9-CM or CPT codes captured in administrative claims data:

- Seizure or convulsions (refer to Table 3 of the original measure documentation) diagnosed during a visit on the day of or day before imaging was obtained
- Head trauma (refer to Table 4 of the original measure documentation or the presence of an E-code) on the day of or within 7 days before imaging was obtained
- Neurosurgical intervention (refer to Table 5 of the original measure documentation) on the day of or within 180 before imaging was obtained
- Secondary headache (refer to Table 2 of the original measure documentation) diagnosed during a visit on the day of or within the 365 days before imaging was obtained
- Medical conditions that could warrant imaging in the setting of headache on the day of or within the 365 days before imaging was obtained (refer to Tables 6 to 10 of the original measure documentation)

Exclusions based on clinical documentation:

- Seizure or convulsions as the indication for imaging
- Trauma
 - Suspected child abuse
 - Concussion
 - Skull fracture
 - Intracranial hemorrhage
- Neurological surgery
- Secondary headache
- Medical conditions that could warrant imaging in the setting of a headache:
 - Infection such as meningitis, brain abscess, HIV and encephalitis
 - Neoplasm, tumor
 - Tuberous sclerosis
 - Blood disorder
 - Hemangioma, phlebitis/thrombophlebitis, occlusion of cerebral arteries, moyamoya disease
 - Hydrocephalus and central nervous system (CNS) anomalies, dwarfism

Exclusions/Exceptions

not defined yet

Numerator Inclusions/Exclusions

Inclusions

The numerator is the number of children, ages 4 through 17 years old, for whom imaging of the head (computed tomography [CT] or magnetic resonance imaging [MRI]) is obtained for the evaluation of primary headache without indications for neuroimaging.

Exclusions

Exclusions based on clinical documentation:

Neurologic deficits lasting 60 minutes or longer on the day of or day prior to imaging
Abnormal neurologic exam between the time of diagnosis and the time of imaging
Signs or symptoms of increased intracranial pressure
Lumbar puncture on the day of or day after neuroimaging

Numerator Search Strategy

Fixed time period or point in time

Data Source

Administrative clinical data

Electronic health/medical record

Paper medical record

Type of Health State

Does not apply to this measure

Instruments Used and/or Associated with the Measure

Unspecified

Computation of the Measure

Measure Specifies Disaggregation

Does not apply to this measure

Scoring

Rate/Proportion

Interpretation of Score

Desired value is a lower score

Allowance for Patient or Population Factors

not defined yet

Standard of Comparison

not defined yet

Identifying Information

Original Title

Overuse of imaging for the evaluation of children with primary headache.

Measure Collection Name

Overuse of Imaging for the Evaluation of Children with Headache or Seizures

Submitter

Quality Measurement, Evaluation, Testing, Review, and Implementation Consortium (Q-METRIC) - Academic Affiliated Research Institute

Developer

Quality Measurement, Evaluation, Testing, Review, and Implementation Consortium (Q-METRIC) - Academic Affiliated Research Institute

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Financial Disclosures/Other Potential Conflicts of Interest

Unspecified

Adaptation

This measure was not adapted from another source.

Date of Most Current Version in NQMC

2016 Jan

Measure Maintenance

Unspecified

Date of Next Anticipated Revision

Unspecified

Measure Status

This is the current release of the measure.

Measure Availability

Source available from the [Quality Measurement, Evaluation, Testing, Review, and Implementation Consortium \(Q-METRIC\) Web site](#) . Support documents also available from the [Q-METRIC Web site](#) .

For more information, contact Q-METRIC at 300 North Ingalls Street, Room 6C08, SPC 5456, Ann Arbor, MI 48109-5456; Phone: 734-232-0657.

NQMC Status

This NQMC summary was completed by ECRI Institute on May 9, 2016. The information was verified by the measure developer on June 29, 2016.

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Production

Source(s)

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